



A study links
sea ice loss
with declines
in polar bear
populations

Melting Arctic sea ice threatens polar bears' survival

If current trends of Arctic sea ice melting continue, polar bears are likely to become extinct in the southern Beaufort Sea region of Alaska and adjacent Canada, according to a demographic analysis led by Hal Caswell of Woods Hole Oceanographic Institution and Christine Hunter of the University of Alaska. The study concluded that climate change, and in particular the melting Arctic ice, is a critical threat to the bears' survival and reproductive rates.

Polar bears need ice as a platform to hunt for their main food source: seals. If the Arctic Ocean has more ice-free days in the summer, polar bear survival and breeding will decline

below the point needed to maintain a viable population, the researchers concluded. The findings contributed to the polar bears' designation in 2008 as a federally protected threatened species.

From 2001 to 2006, scientists from the U.S. Geological Survey conducted an extensive survey of the Southern Beaufort Sea polar bear population. The USGS enlisted Caswell and Hunter, mathematical ecologists who specialize in population dynamics models, to advise the team.

Caswell and Hunter used novel analytical methods to develop new models that

incorporated USGS-collected information about polar bears' mortality rates, birth rates, life cycles, and habitats. They coupled these models to projections of Arctic climate changes, especially forecasts of sea ice conditions. They calculated the interplay of all these factors—"some 10,000 simulations," Caswell said—to estimate the probabilities of future polar bear population growth or decline.

"One of our challenges in this analysis was the incorporation of uncertainty," Caswell said. "Each parameter in the model is an estimate, with associated statistical uncertainty. But in spite of the uncertainty, the conclusions about population decline and the critical effects of sea ice changes on that decline are robust."

The population models suggested that 130 "ice-free" days is a threshold, constituting a "bad-ice" year that has negative impacts on the polar bear population. The frequency of "bad-ice" years is critical: If they occur too often (more often than once every six years or so), the bear population shrinks, the scientists said.

Climate models predict that bad-ice years will occur more often in the future, as the Arctic warms. That projects a dire future for polar bears, though some small populations might hang on in isolated regions where ice remains, Caswell said.

In 2008, Caswell received a two-year award for \$225,674 to support his analysis of polar bear populations.

For more information, see the 2010 paper "Climate change threatens polar bear populations: a stochastic demographic analysis" in Ecology: www.esajournals.org/doi/abs/10.1890/09-1641.1

